

## **Toggenburg Cluster Analysis Summary September, 2014**

Data was obtained from the ADGA for 8 dairy breeds. All results were limited to those animals reported as Purebred (PB) or American (AM); however, all animals were included in the pedigree analysis to establish ties between animals, including cases where the ancestors are from another breed. Cluster analysis is a procedure that groups related animals based on pedigree relationship. This is a technique used by NAGP to assess where repository animals are grouping with the currently available genetic pool for each breed. It also establishes a practical approach for obtaining animals for the repository in a way that maximizes genetic diversity. Animals that were included in the cluster analysis included sires of PB and AM offspring born 2010 to present that are also PB or AM themselves. Repository bucks are also included in the clusters.

Table 1 shows the summary statistics based on the pedigree and cluster analyses.

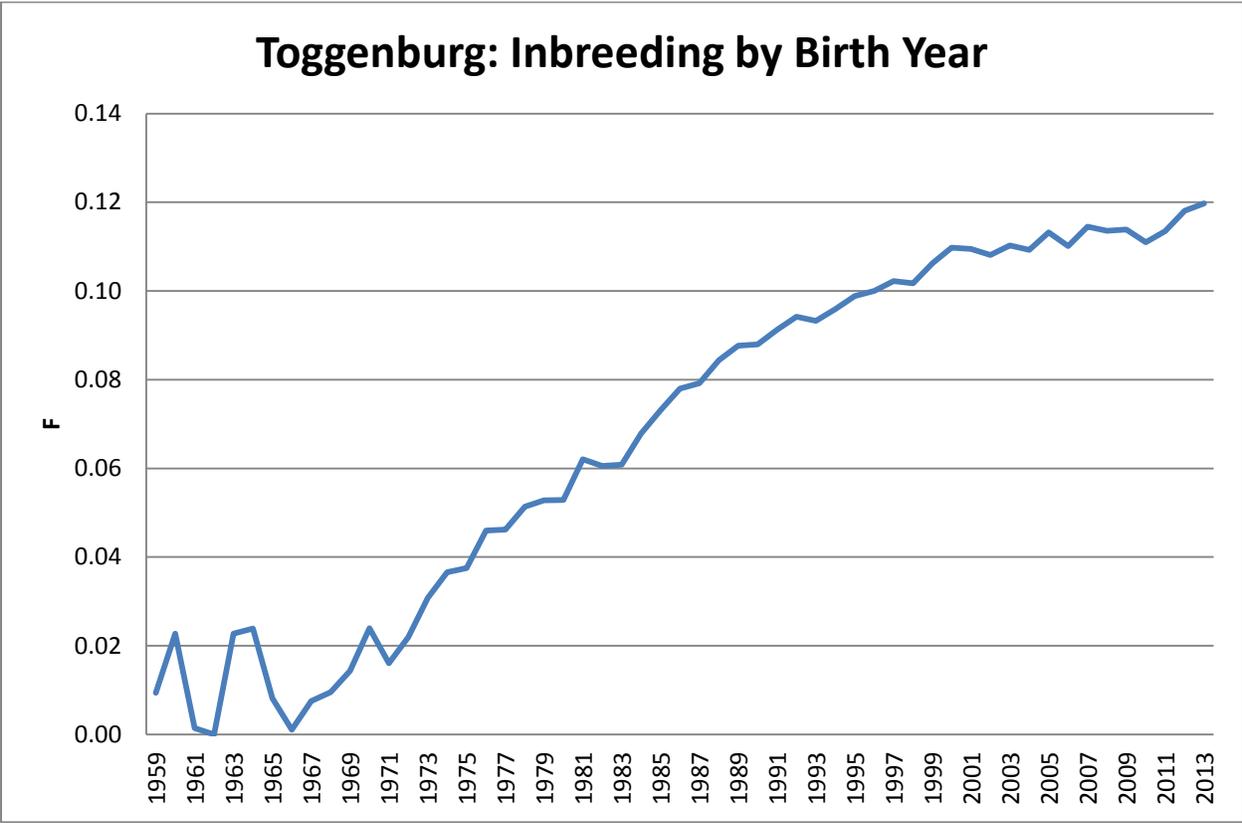
Table 1. Summary statistics for Toggenburg

	Toggenburg
Animals that are PB or AM	110,835
Full pedigree file (until all ancestors are unknown)	126,617
Unique sires	12,291
Unique dams	42,538
Mean inbreeding (F)	0.086
F range	0 – 0.62
Repository bucks	2
Clustered bucks	1,252

### **Pedigree & Inbreeding Analysis**

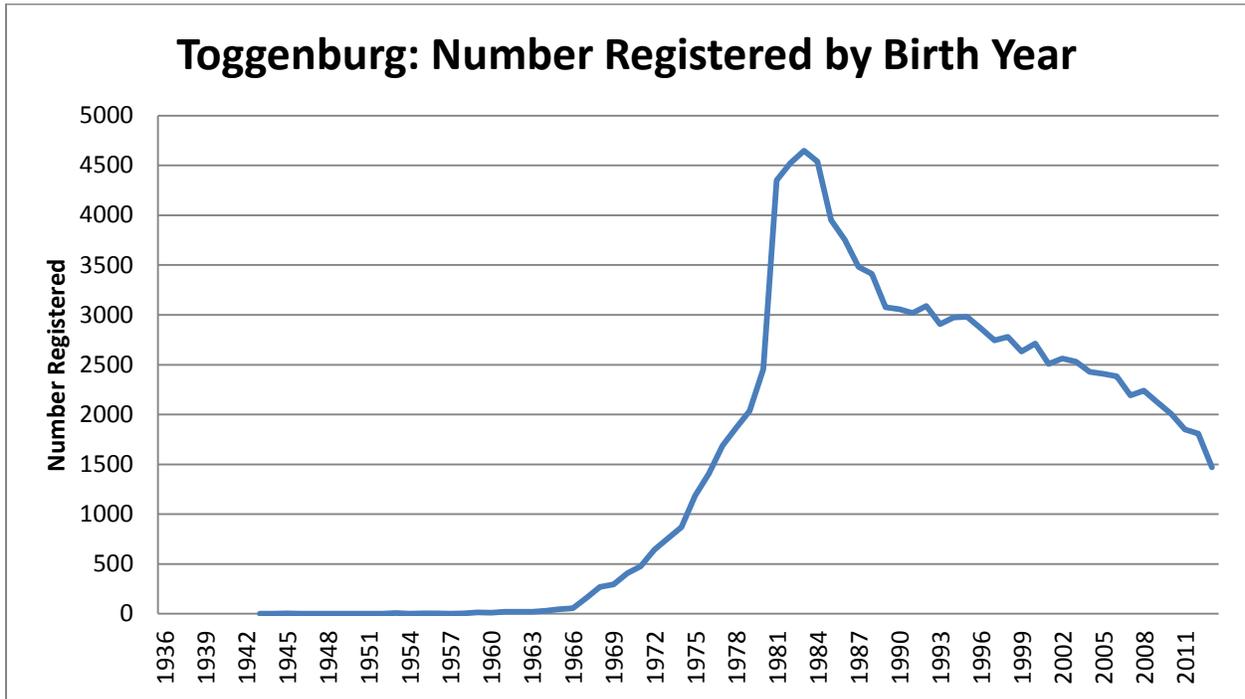
Inbreeding levels have steadily increased over time. Animals born in 2013 have an average inbreeding level of 12%, approximately the relationship of cousins.

Figure 1. Toggenburg inbreeding trend by birth year



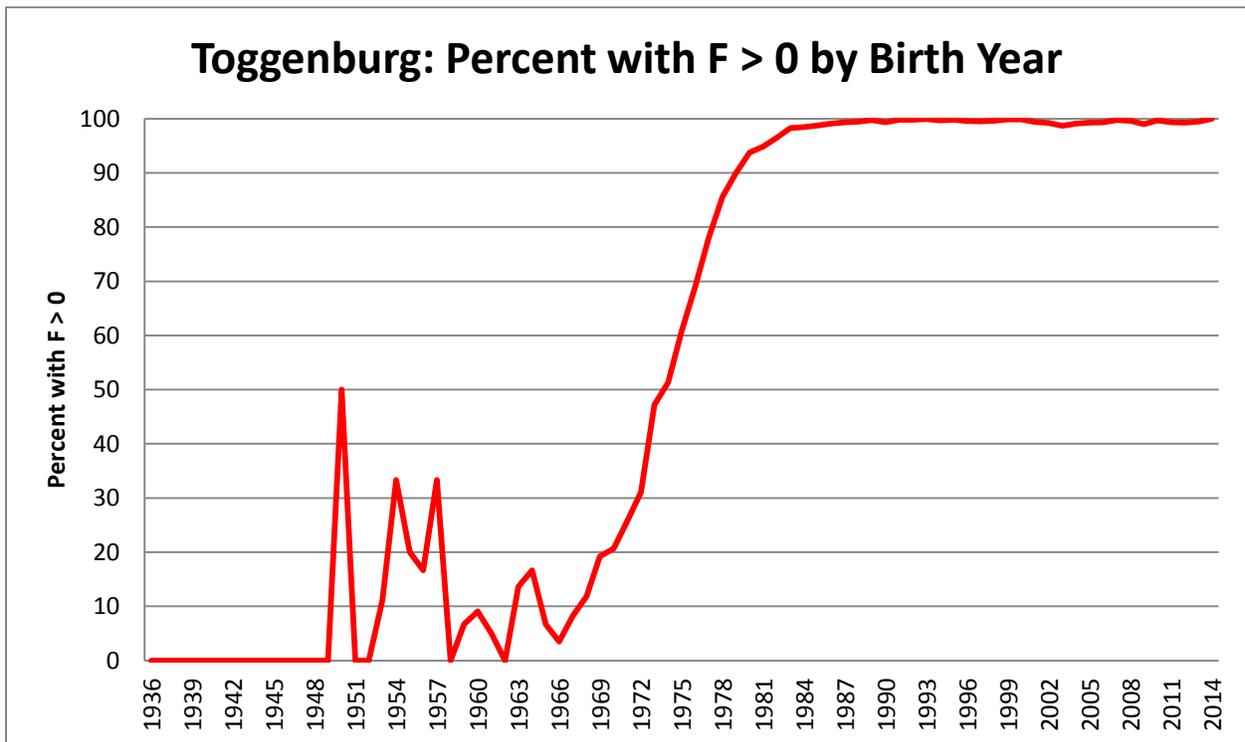
Number of registrations peaked for birth year 1983 at 4,648; registrations for birth year 2013 were 1,471.

Figure 2. Toggenburg goats registered by birth year



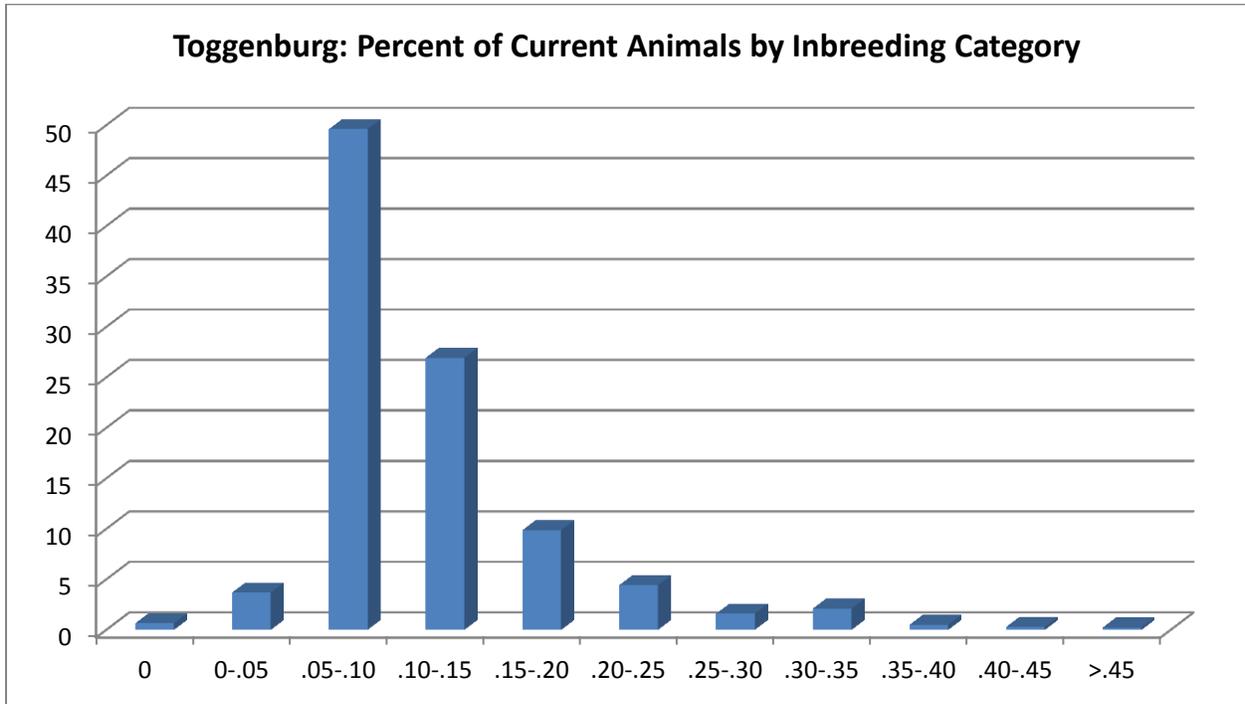
Almost all Toggenburgs born in the past 20 years have some level of inbreeding, as shown in Figure 3.

Figure 3. Percent of Toggenburgs with an inbreeding coefficient greater than zero by birth year



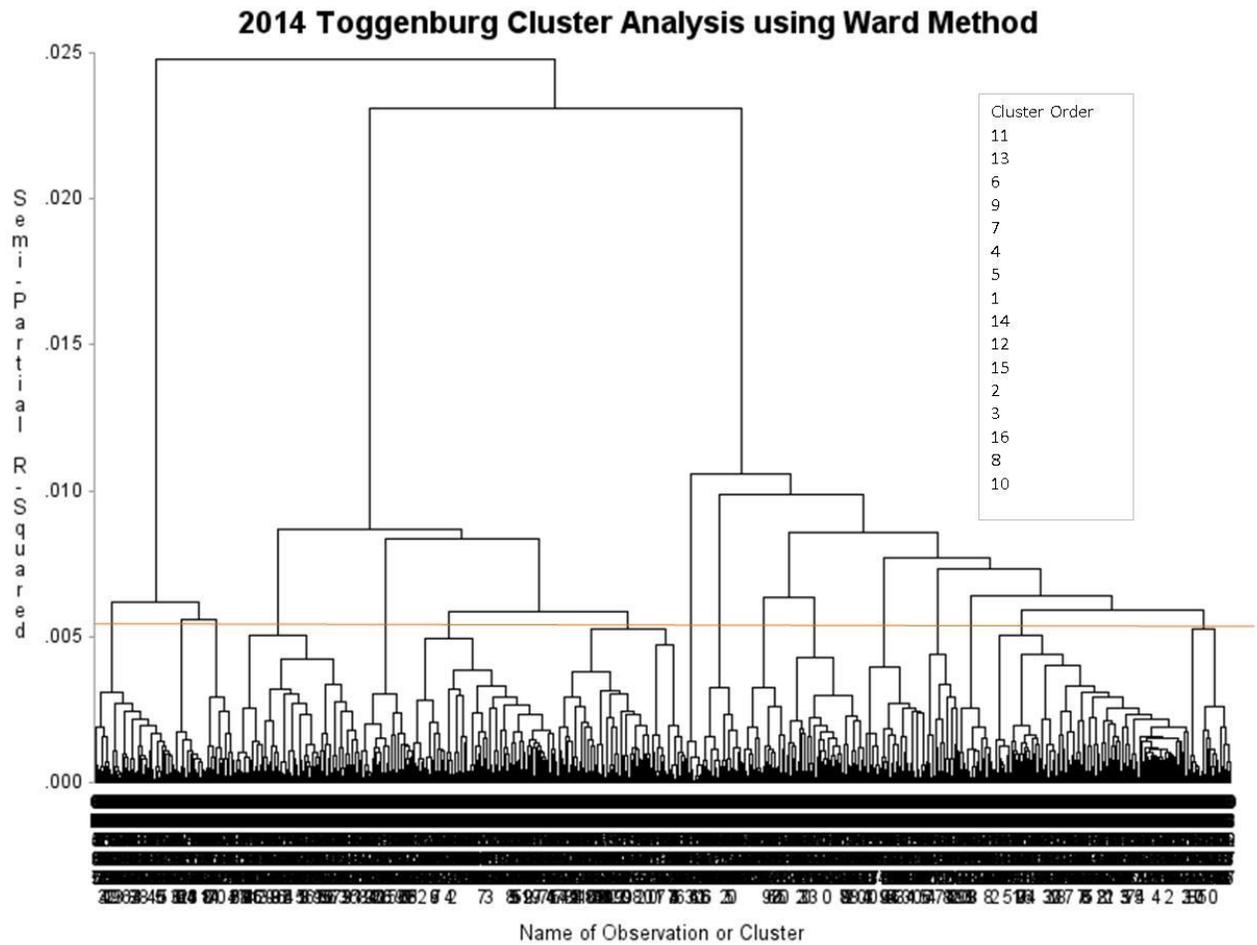
Fifty-four percent of the current (born 2009 and later) Toggenburg population has an inbreeding coefficient of less than 0.10.

Figure 4. Percent of Toggenburgs born 2009 and later by inbreeding category



Sixteen clusters were selected to represent the populations within the Toggenburg breed (Figure 5).

Figure 5. Tree diagram for Toggenburg cluster analysis of sires of PB and AM offspring born 2010 and later that are PB or AM themselves (gold line depicts cluster level)



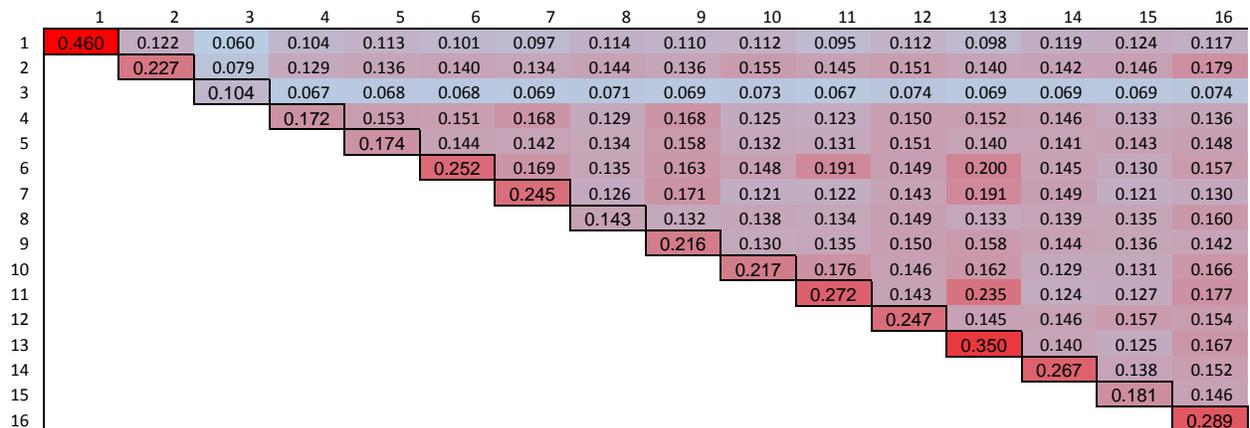
The 1,252 clustered bucks had an average relationship of 14.1%. There are only two Toggenburg bucks in the repository, and they are represented in Clusters 5 and 8. Table 2 shows the cluster summary.

Table 2. Toggenburg cluster results showing the number, mean, and variance for between and within cluster relationships in addition to repository bucks

Between Clusters				
	n	Mean	Variance	
	1252	0.141	0.002	
Within Cluster				
	n	Mean	Variance	
			Bucks in Repository	
Cluster 1	19	0.460	0.026	
Cluster 2	67	0.227	0.008	
Cluster 3	36	0.104	0.015	
Cluster 4	159	0.172	0.004	
Cluster 5	141	0.174	0.005	1
Cluster 6	34	0.252	0.012	
Cluster 7	58	0.245	0.009	
Cluster 8	215	0.143	0.003	1
Cluster 9	138	0.216	0.006	
Cluster 10	46	0.217	0.012	
Cluster 11	88	0.272	0.007	
Cluster 12	47	0.247	0.010	
Cluster 13	33	0.350	0.010	
Cluster 14	45	0.267	0.011	
Cluster 15	87	0.181	0.005	
Cluster 16	39	0.289	0.010	

Although the within cluster relationships (diagonal) are generally higher than the between cluster relationships (off-diagonal), there are many high relationships between clusters (Figure 6).

Figure 6. Within and between cluster relationship matrix for Toggenburg



The Toggenburg repository bucks did not have current PTA available; nonetheless, PTA for the breed average for Milk, Fat, and Protein are shown in Figures 7, 8, and 9, respectively.

Figure 7. Toggenburg genetic trend for Milk PTA

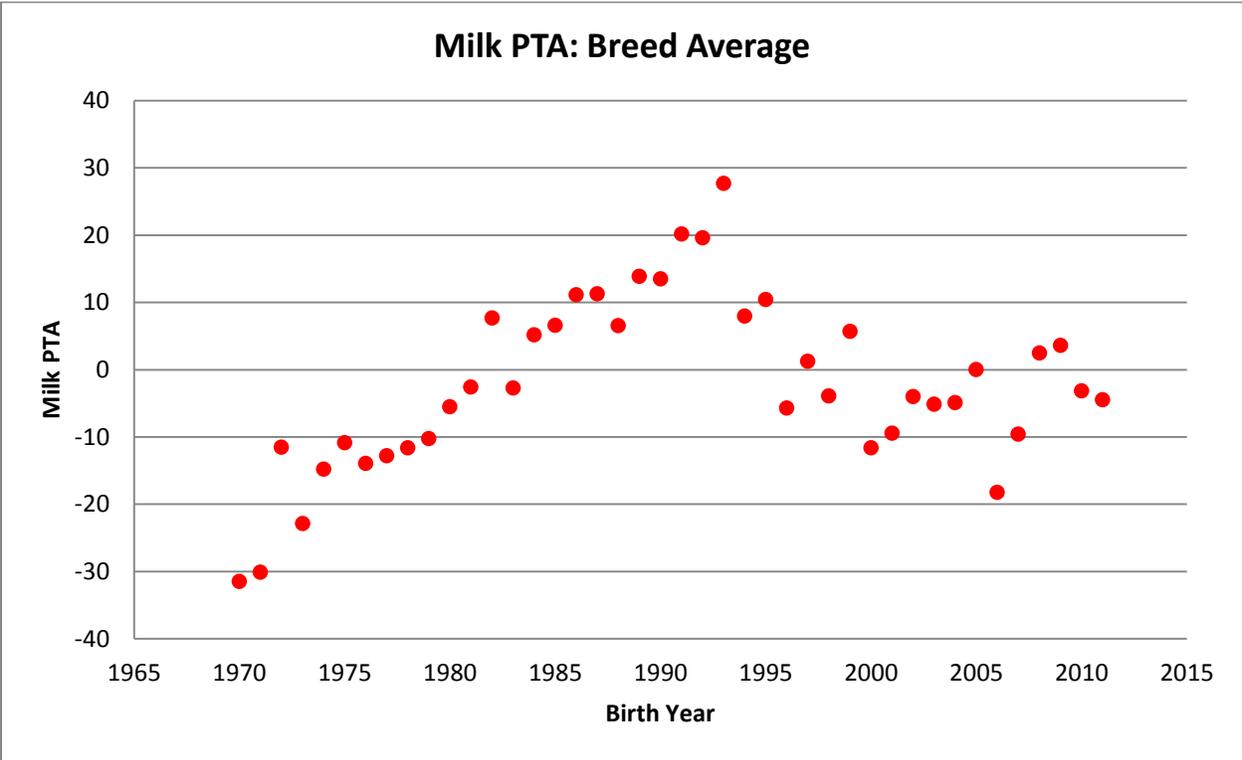


Figure 8. Toggenburg genetic trend for Fat PTA

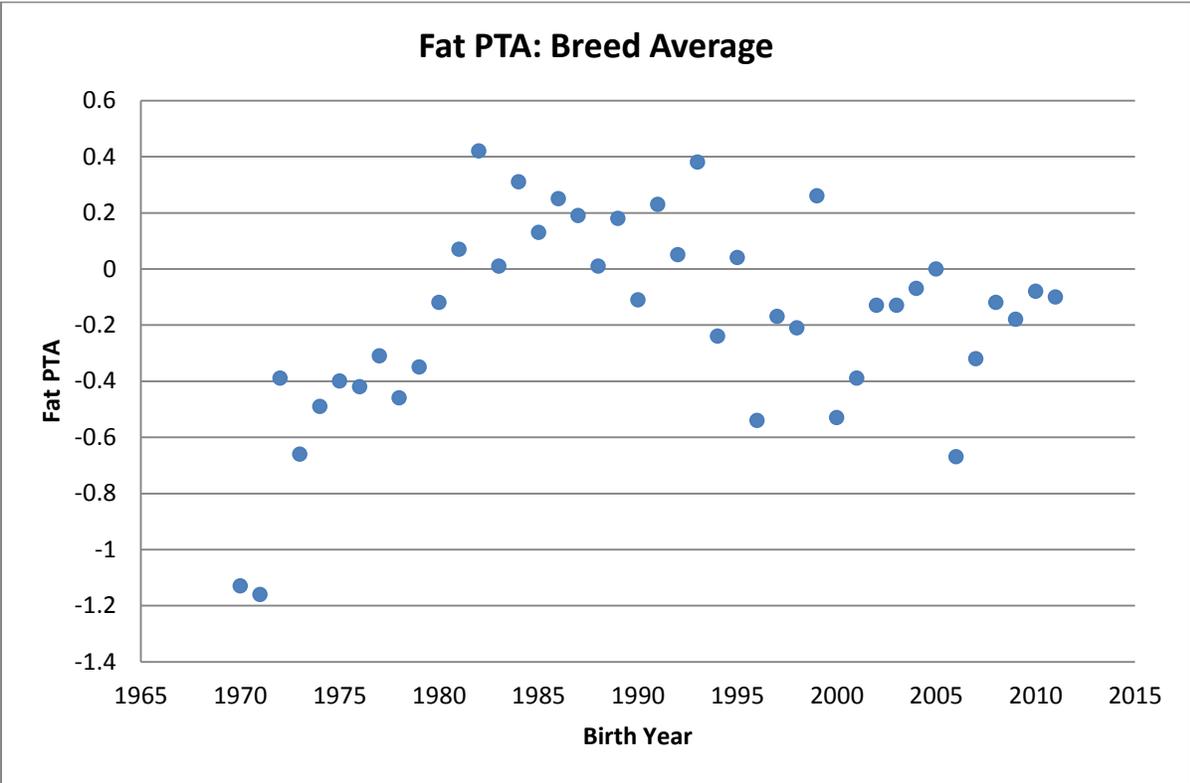


Figure 9. Toggenburg genetic trend for Protein PTA

